RESEARCH HIGHLIGHT

Smart Technologies in Affordable Seniors Housing

INTRODUCTION

Demographic trends clearly show that the Canadian population is aging. In Ottawa alone, the number of seniors is now approximately 103,000 and will more than double to 230,576 by 2031. Furthermore, research indicates that the majority of older adults across Canada prefer to remain in their home as long as possible.

In addition, the ability to meet the desired option of senior adults to age in place represents tremendous cost savings to the healthcare industry. As a result, there is increasing market demand and potential for the introduction and/or retrofitting of housing with innovative technologies aimed at keeping older adults in their homes for longer periods.

The TAFETA Program of Research, a partnership of the Elisabeth Bruyère Research Institute and Carleton University, develops unobtrusive technologies to help older adults live independently – a term which is often referred to as "aging in place." The program, which began in 2003, is one of only three smart technology research initiatives in Canada. Since inception, the TAFETA research team has successfully developed a variety of smart technologies that range from visual lighting cues which are capable of guiding home occupants in the dark to prevent falls, to pressure-sensitive mats which are placed under a mattress to monitor sleep abnormalities and predict premature stroke activity.

The majority of these smart technologies are integrated in a living laboratory called the TAFETA Smart Apartment located at the Elisabeth Bruyère Hospital. In addition, these smart tools are connected to a central computer to monitor activity within the smart home environment.

Amongst the technologies is a magnetic "smart voice" fridge sensor that provides an audible cue to the home occupant when the fridge door is left open for pre-programmed time intervals.

The smart voice fridge sensor – the subject of this research study – serves two purposes for the older adult: (1) it provides a practical reminder to the home occupant to close the fridge door to prevent food spoilage and (2) through a central computer connection, it provides a warning signal to indicate activity/inactivity levels to identify potential health issues to care providers monitoring the home activity (e.g., the fridge remains open or closed for extended periods of time representing a potential problem).

This study investigated the migration of this technology to an affordable community housing unit to gather data from real-life users and evaluate the sensor's feasibility as an innovative technology to help older adults age at home.

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OBJECTIVES

It was hypothesized that the smart voice fridge sensor is a reliable and cost-effective tool which can be successfully integrated into seniors' housing units. Prior to conducting this study, it was believed that the product would be accepted by its users (elderly home occupants, family members and care providers) as an innovative technology to facilitate aging in place.

The specific research objectives were to (1) to evaluate the user acceptance of this technology and (2) evaluate the reliability of the system for larger scale implementation.

METHODOLOGY

Research Site – The site of this research study was an affordable housing unit in Ottawa, Ontario located at 600 Kirkwood Avenue. The housing unit is operated by the Community Care Access Centre (CCAC) and Ottawa West Community Support (OWCS) – partners in our research.

Participants –12 apartment occupants residing in the housing facility were approached for recruitment in this study between February and April of 2010. A total of 11 participants (mean age 75, 2 male) agreed to participate.

Technology Design – A total of five prototype fridge sensors were procured for this study. The fridge sensor is an approximately 5x5 inch metallic box comprised of a magnetic switch and software components to create a voice prompt, or cue, that says "the fridge/freezer door is open." Each fridge sensor consists of a compilation of hardware modules that were tested separately prior to site installation.

Data Collection

- *Activity Tracking* – A single fridge sensor was installed in each participant's apartment for a period of six weeks. The time at which both the fridge and freezer door was opened and closed was recorded in a log text file with detailed time stamp (date/hour/min/sec) of all activity.

- *Pre- and Post-Installation Surveys* – A survey was conducted upon installation and post-installation. Survey data gathered included details regarding the volume of the fridge sensor audible cue, preference for female or male voice for the audible cue and also whether participants would prefer a fridge with or without a sensor.

Data Analysis – Data collected over the six-week period was in two formats: (1) log text files indicating fridge and freezer door activity and (2) responses to the pre- and post-installation surveys. All data was entered into an SPSS 17 database for analysis.

FINDINGS

Findings are grouped in two categories: (1) Acceptability and (2) Patterns and Alarms.

(1) *Acceptability* – Results indicated that 8 participants had no preference for voice cue gender before or after the trial and 9 participants indicated that they did not find the voice sensors annoying. Additional results are outlined in Figures 1 and 2.

		Before Trial	After Trial
Usefulness: **Was the sensor useful?**	Yes	3	5
	No	1	6
	Unsure	7	0
Volume: **Was the sensor too loud?**	Yes	3	2
	No	8	9
	Unsure	0	0

Figure 1 Pre- and post-installation questionnaire data

- no preference
- fridge without sensor
- fridge with sensor

Response to question:"If you had a choice, would you prefer to have a fridge with a fridge sensor or without"
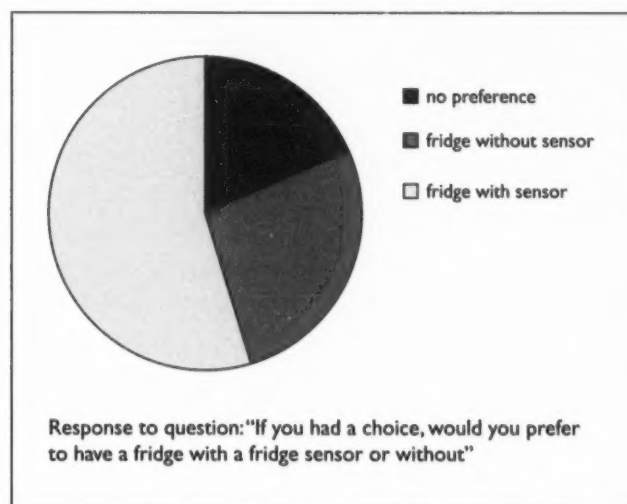
Figure 2 Fridge sensor preferences of participants

(2) *Patterns and Alarms* – A total of 28 days of consecutive data in a month for 8 participants was analyzed. Within this time period, fridge and freezer door frequencies of 281-1698 were identified. Two alarm conditions were presented: (1) No fridge activity for 8 hours (5 am to 9 pm) results in an alarm and (2) No fridge activity for 4 hours (8 am to 2 pm) results in an alarm. Three fridge activity patterns were identified. Additional details are outlined in Figure 3.

Fridge Activity Pattern	# of alarms condition (1)	# of alarms condition (2)
Bimodal	28	99
Trimodal	3	72
Multimodal	5	20
Total	36	191

Figure 3 Total number of alarms that were set off under condition (1) and (2) for each group in a 28 day period.

CONCLUSIONS AND RECOMMENDATIONS

The ultimate goal of the TAFETA Program of Research is to develop technology to facilitate aging in place.

In terms of *acceptability*, findings of the study are in line with research which indicates a larger number of elderly people will accept smart technologies, such as the smart voice fridge sensor, to help prolong their independence. The participants recognized the technology's future potential and indicated a preference for fridges with the technology verses fridges without, despite the fact that these individuals did not feel that they needed a smart voice fridge sensor at that time.

In terms of *patterns and alarms*, three predominant patterns of fridge usage among participants were identified.

In addition, a full test report outlining the robust performance of the units was generated.

Further studies are needed to confirm both user acceptance of the alarm system and to determine whether the alarms actually correlate to adverse health conductions. In addition, a larger sample size is required with a population that lives in a diverse residential setting and includes individuals with more diverse health conditions to further validate the acceptability of this technology.

To further validate the concept of "smart housing" amongst older adults, the research team will direct its next steps towards integrating multiple sensors to capture more robust data sets that yield more detailed information regarding the community dwelling older adults' health status.

The ultimate goal of the team is to further demonstrate the viability of such technologies in promoting independent living amongst older adults and facilitating the development of such devices for market.

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